A REVIEW OF RODENT CONTROL PROGRAMS IN NEW YORK STATE

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ABSTRACT: The history of rodent control programs in New York State is reviewed, beginning with state-funded efforts in August, 1967. In 1969, Federal rodent control grant funds were used to establish four Model Cities programs. At its peak in 1970, programs were active in 18 counties, eight cities and villages, and in six Model Cities areas. The program encompasses all the major metropolitan areas of the state, serving some nine million persons.

As part of the state program, the Rodent Control Evaluation Laboratory was established to investigate chemosterilants as a means of rodent control and to develop knowledge of pest rodent biology. Since then, the investigations program has turned to the problem of rodent resistance to anticoagulant rodenticides both in New York and other states in the eastern United States.

Initial rat infestations, which ran 24.4 percent statewide in 1969, have been decreased 84 percent by late 1973. Similarly, in the same time period, unapproved refuse storage deficiencies were decreased 55.6 percent and exposed garbage conditions declined 44.7 percent. Rat bites showed a 40 percent decrease during these same years. By all measures, then, the program has been a success.

Most programs have relied heavily upon anticoagulant rodenticides in the chemical control or rodent populations. Zinc phosphide, red squill, and norbormide are also used.

Harborage removal and environmental improvement are stressed through active cleanups and educational efforts. During the four-year period, 1969-1972, some 177,000 tons of rat harborage were removed from 66,000 premises in the state.

INTRODUCTION

In August 1967, after the U.S. Congress had debated and then defeated a proposed rat control bill for inner city slums, Governor Nelson A. Rockefeller requested of the New York State Legislature, and received, an appropriation for a statewide rodent control program. Thus began a unique and innovative experiment in a social, political, and biological program. Governor Rockefeller stated:

> "Few manifestations of the decay that gnaws at the cores of our central cities are more tragic and degrading to urban residents than rat infestations. Rats carry disease, destroy valuable property, cause fires and menace human life.
>
> "Yet cities have been unable to cope with this health hazard. Despite the hopes of many of us who are concerned with the future of our great cities, the Federal government apparently will not provide the help so urgently needed.
>
> "Accordingly, I recently requested a report from the State Department of Health concerning the extent of the rat problem in New York State. Based upon this report, and with the agreement of the legislative leaders, I am pleased to announce that New York State will embark at once upon a statewide rat control program..."

Administrative responsibility for this new program was given to the New York State Department of Health and program development and supervision, contract preparation and administration, consultation, training, and evaluation were provided by the newly created Bureau of Rodent Control. At the time the Bureau of Rodent Control was established, the Rodent Control Evaluation Section was set up as a part of the Bureau's program. The purpose of the Rodent Control Evaluation Section was to study the ecology and reproductive biology of pest rodents, to evaluate and develop chemosterilants, rodenticides, and any other promising techniques as a means of rodent control, and to provide technical support to the state and local health unit rodent control programs.

During the initial year of the program, each local health agency received 100 percent assistance funds from the state to start their programs. Each year thereafter, the state share has decreased by 10 percent, eventually reaching in the sixth program year a 50-50 funding formula. By the sixth program year all programs were expected to be into maintenance phases in most of their target areas.

The local health units are involved in comprehensive rodent control programs, conducting neighborhood surveys, utilizing environmental improvement procedures of harborage and garbage cleanup and removal, demolition of dilapidated buildings, neighborhood and school educational programs, environmental and housing code enforcement, and rat killing measures. Many of the personnel employed on the programs are drawn from the urban poverty target areas of the communities involved.

In 1969, New York State applied for Federal grant funds for rodent control programs in Model Cities projects in the state and began Federally-funded projects in Buffalo, Rochester, Poughkeepsie, and New York City. In subsequent years, projects were added in Syracuse, Binghamton, and Cohoes.

At the peak of the New York State program in 1970, programs were active in 18 counties, eight cities and villages, and there were Federally-funded programs in six Model Cities. The program encompassed all the major metropolitan areas in the state, served some estimated 9,070,000 persons, or about 50 percent of the state population.

ASSESSMENT OF THE RODENT PROBLEM

Urban Areas

The full extent of the rodent problem in urban neighborhoods was not known at the beginning of the program in 1967. Knowledge of the magnitude of rodent infestations has been obtained from the block by block surveys carried out by each local health agency, by the New York State Department of Health and by the Bureau of Community Environmental Management of the U.S. Department of Health, Education, and Welfare. Data for surveys in urban deteriorated neighborhoods are given in Table 1. These data indicate that initial rat infestations in two dozen communities across New York State range from a low of 3.5 percent in Syracuse to a high of 41.9 percent of all surveyed premises in the city of Newburgh. The problem of rat infestations is not restricted to large urban centers but also is seen in significant prevalence in smaller cities and villages. These smaller cities and villages, especially, lack the resources to properly deal with the problem without outside help. When surveys of suburban and rural premises were added to the urban premises surveyed, it was found that of 79,840 premises checked, 19,512, or 24.4 percent of the total were actively infested with rats.

Table 1. Rat infestations in urban neighborhoods in cities and villages in New York State, 1969-1970.

City	Percent Rat Infestations	City	Percent Rat Infestations
Albany	33.2	New Rochelle	7.1
Amsterdam	40.3	New York City	11.2
Beacon	25.4	Niagara Falls	31.1
Binghamton	14.8	Owego	8.2
Buffalo	15.8	Port Jervis	30.8
Chester	18.4	Poughkeepsie	24.9
Dunkirk	24.0	Rochester	30.2
Highland Falls	11.1	Schenectady	13.4
Hornell	27.4	Syracuse	3.5
Jamestown	26.3	Troy	14.4
Middletown	5.1	Utica	10.7
Newburgh	41.9	Warwick	16.5

Rats on Farms

Norway rats and house mice occur throughout the lowland areas of New York State, being absent only from the higher mountainous areas of the Adirondacks and the Catskills. Rural rat infestations were believed to be even more common than urban ones but factual data to support this belief were lacking.

A survey of farm premises was planned and carried out in the summer of 1971 by staff of the Bureau of Rodent Control and by the Cattaraugus County Health Department in that county. The objectives of these surveys were to gather factual data on the prevalence of rats and mice on farms, to determine how farmers coped with rodent problems, and to determine if there was a need for a rural rodent control program.

A total of 630 farms were inspected in 15 rural counties. Active rat infestations were found on 339 farms (54 percent of those surveyed). Farms most often infested were dairies, poultry farms, hog farms, and horse stables.

Two-thirds of the farmers interviewed indicated they carried out their own rodent control, primarily utilizing anticoagulant bait materials obtained from retail sources. They indicated they would appreciate help and information on farm rodent control. Some were aware of the anticoagulant resistance problem in rats and expressed concern that it might occur in New York.

Rats in Sewers

Norway rats live in sewers and storm drains in communities throughout the state. Surveys of sewers in more than 60 communities in New York in 1969 revealed that rat signs were evident in 18,079 sewer manholes out of 44,889 inspected (40.3 percent of the total).

Plans were accordingly developed to deal with this underground reservoir of rat populations to reduce the economic damage they inflict on sewer and drain pipes and to reduce the disease hazard of rats from sewers entering houses, restaurants, and markets.

PROGRAM PROGRESS

The progress of each program was evaluated by the staff of the Bureau of Rodent Control on an annual survey and a continuing surveillance activity. Evaluation surveys in Model Cities areas were done cooperatively with personnel from the U.S. Department of Health, Education, and Welfare. Progress was measured by several parameters: changes in percentage of rat infestations in surveyed premises, in the percentage of premises with unapproved refuse storage and exposed garbage conditions, and in the number of confirmed rat bites reported by the projects annually.

Data presented in Table 2 indicate that overall reductions in the rat populations in New York State in the five-year period are estimated at 84 percent. The decrease per year is shown graphically in Figure 1. This is an excellent record compiled by the local health agency rodent control programs. At the peak of neighborhood surveys in 1971, a total of $184,498 premises containing 674,105 living units was inspected. This comprises approximately 10 percent of all living units within the state, a remarkable feat in itself.

Table 2. Statewide rat infestations in New York State.

Year	Number of Blocks Surveyed	Number of Premises	Number of Premises With Rats	Percent Rat Infested
1969	2,962	79,840	19,512	24.4
1970	5,688	139,639	21,677	15.5
1971	12,130	184,498	22,515	12.2
1972	8,877	144,612	11,738	7.1
1973	6,187	92,082	3,641	3.9

Likewise, the environmental improvements, as measured by decreasing numbers of premises with unapproved refuse storage and exposed garbage deficiencies, are shown in Figures 2 and 3. Unapproved refuse storage deficiencies declined from 63 percent of all premises in 1969 to 28 percent in 1973, a decrease of 56 percent. Exposed garbage conditions, not surveyed until 1970, declined from 26.4 percent of all premises that year to 14.6 percent in 1973, a decrease of 45 percent. Modest as these environmental improvements may seem, it must be remembered that they were accomplished in the most deteriorated urban neighborhoods in the state.

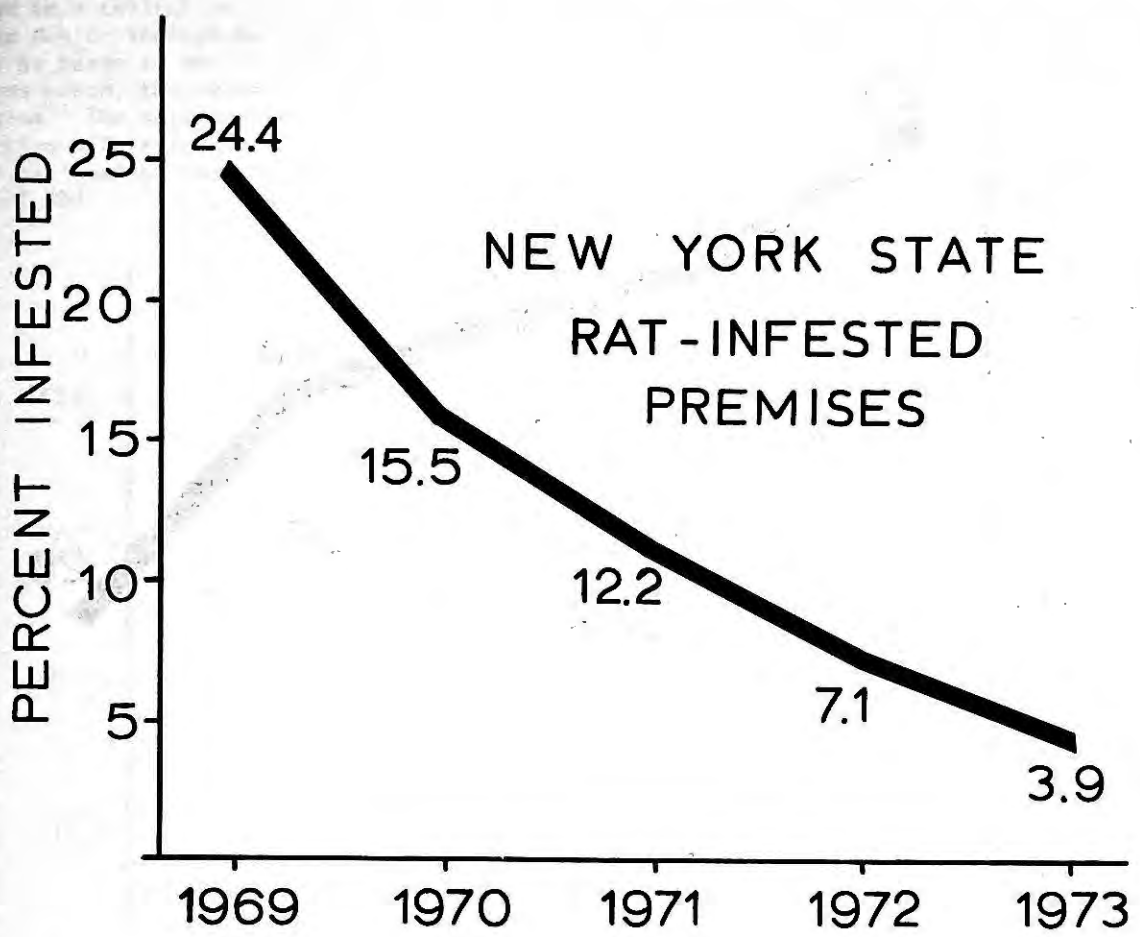

Figure 1.

The victims of rat bite are most often children under 10 years of age, or bedridden invalids. The threat of rat bite is a constant worry of the poor in disadvantaged areas. Since 1969 all city and county rodent control programs have recorded the number of reported rat bites and the number that project personnel have confirmed as actually due to rats, upon investigation. These confirmed rat bites are given in Table 3 and shown graphically in Figure 4, for the major metropolitan areas in New York State. During the five-year reporting period, rat bites were decreased by 40 percent. These numbers are estimated to be only about 10 percent of all rat bites that occur. Since about 100 less bites were reported and confirmed in both 1972 and 1973, as compared to 1969, it is estimated that the rodent control programs throughout New York State prevented almost 1,000 rat bites in each of those program years.

Table 3. Rat bites, confirmed reports, major New York metropolitan areas number of confirmed rat bites.

Metropolitan Area	1969	1970	1971	1972
Albany	16	11	3	5
Binghamton	0	1	1	9
Buffalo	17	3	9	11
Long Island	36	42	16	9
New York City	178	187	201	131
Rochester	18	13	30	7
Syracuse	5	4	1	0
TOTALS	270	261	251	172

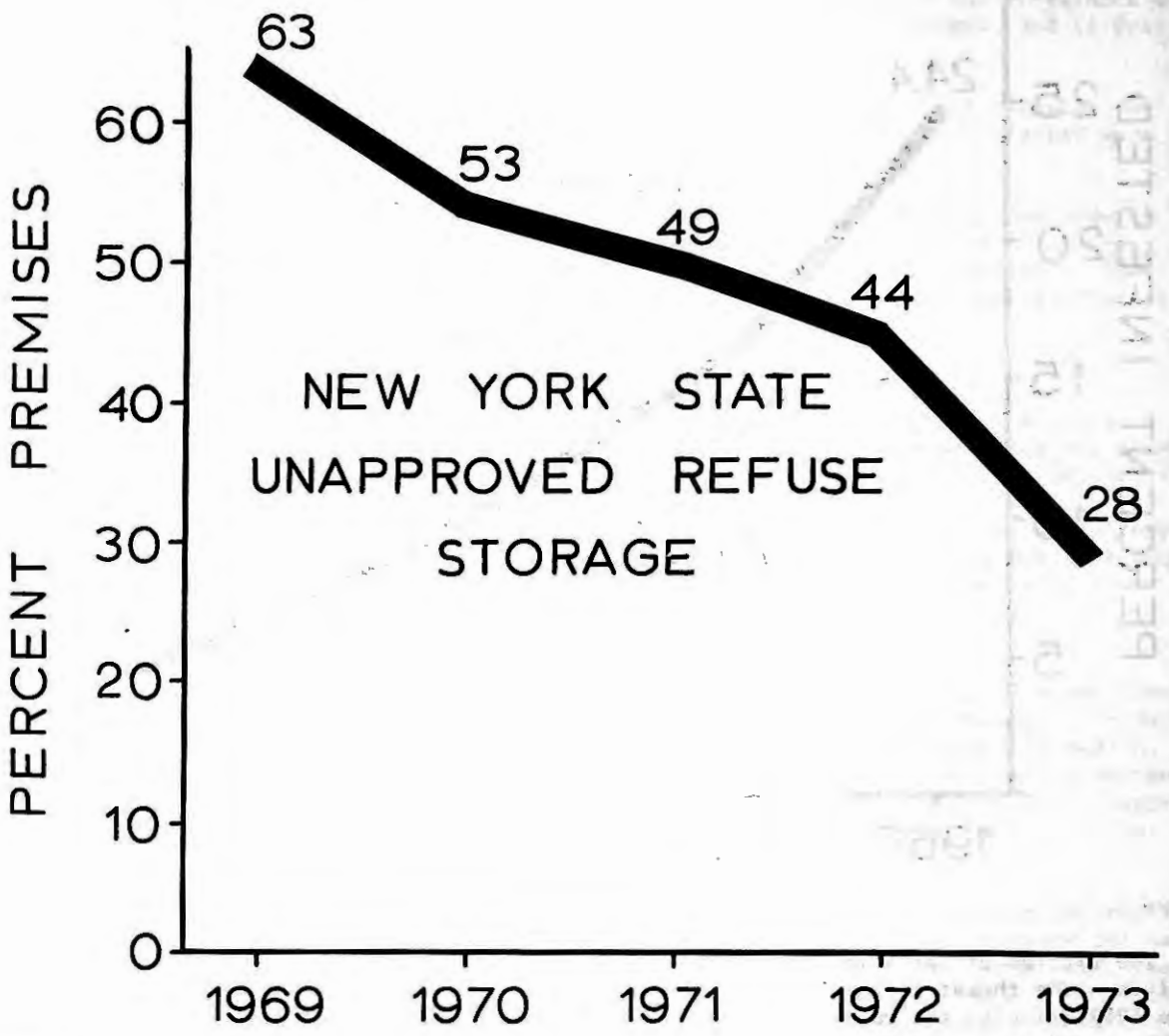

Figure 2.

Harborage Removal

The accumulation of junk and rubbish on residential and commercial premises provides rats and mice with the shelter they require to survive. This material is referred to as rat harborage. It consists of abandoned automobiles; abandoned appliances, lumber and wood on the ground, large rubbish items such as furniture, tires, mattresses, and rubble; dilapidated outbuildings; deteriorated board fences and walls; and weeds, grass, and brush. During the four-year period 1969-1972, a total of 177,000 tons of rat harborage was removed from approximately 66,000 premises. This is equivalent to all the solid wastes produced by the city of Albany in an 18-month period. These efforts have gone far in keeping the urban residential environment clean and free of exposed food and harborage.

Junk Car Program

The removal of abandoned vehicles was an essential part of harborage removal in several of the local health agency rodent control programs. These vehicles not only provide rodent harborage but sometimes are used as a focal point for bags of refuse and other debris. In New York City, hundreds of vehicles are abandoned daily on the streets and in vacant lots.

In 1970 the State Health Department through the Bureau of Rodent Control initiated a demonstration project to remove abandoned vehicles in Columbia County. Each village and town in the county was surveyed and the location of abandoned vehicles marked on maps. Ordinances were instituted in each town and village and collection sites were set up where unwanted vehicles could be left, usually at the town or village dump. When a car was

towed to a collection site, the contractor doing the hauling was paid $5.00 per car. The scrap dealer then picked up the cars at the collection site, hauled them to a crusher, and then by barge to New Jersey, to a fragmentizer. In instances where there were several hulks in one place, the scrap dealer hauled them directly to his crusher without any cost to the program. The scrap dealer also paid for vehicles delivered directly to his dock site location. This resulted in the average cost per car removed from the county to be $1.36. In a two-year period, 14,000 vehicles were removed from the county at a cost to our program of $17,000.

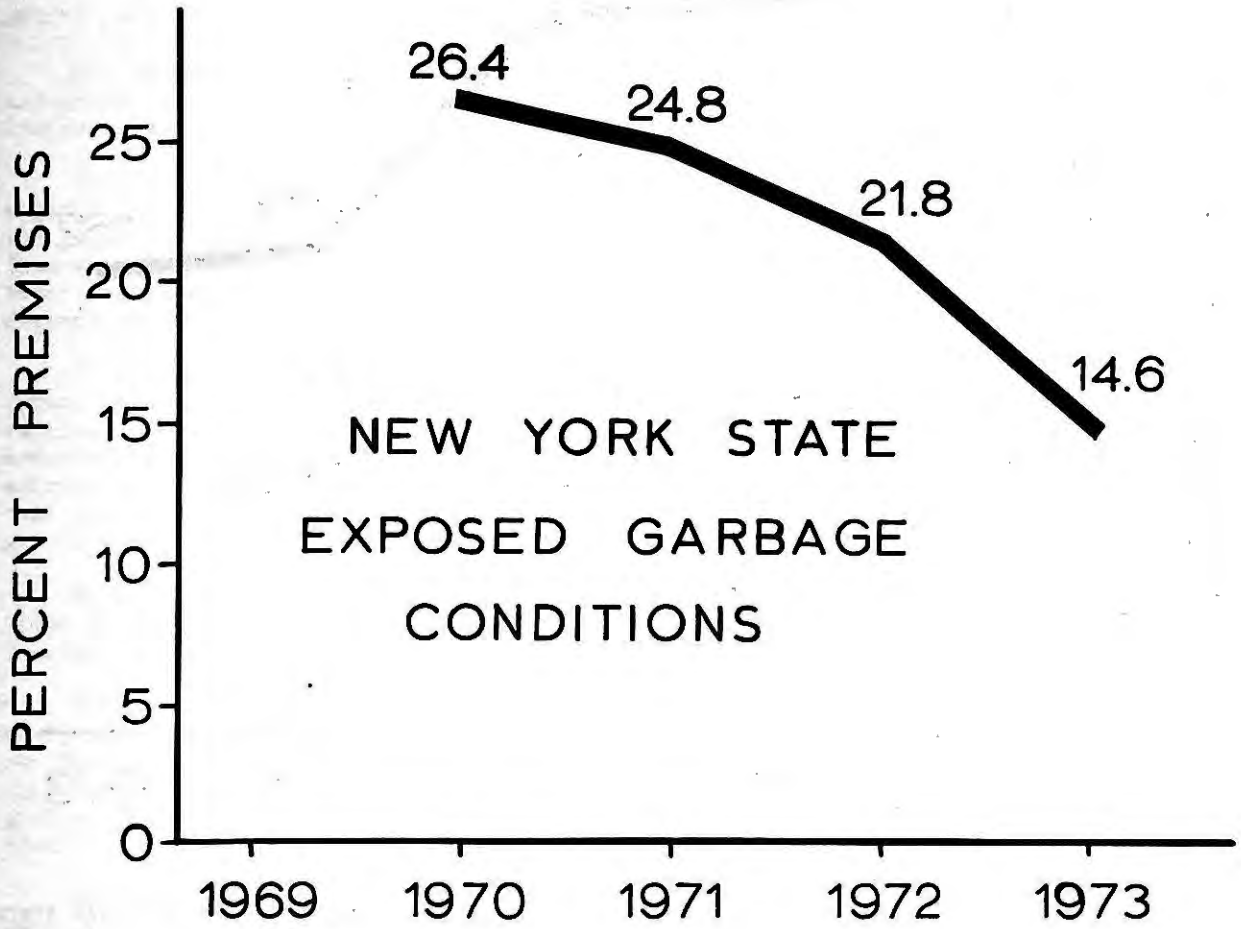

Figure 3.

Films and School Curricula Materials

The Bureau of Rodent Control, through its contractual arrangements with local health programs, and through the participation of the staff and use of the Rodent Control Evaluation Laboratory, has helped produce a series of nine rodent control training films or film documentaries. Films and coordinated student workbooks and teachers' guides are available for grades four through 12. A notable recent achievement was the production of the television documentary film, "Ratopolis," by the National Film Board of Canada. A major portion of this documentary was filmed in the Rodent Control Evaluation Laboratory.

Attack/Maintenance Programs

The initial phases of a rodent control program are concerned with identifying the problem areas through detailed surveys, planning the programs and then implementing a comprehensive environmental improvement, rodent extermination, and public education program. This phase of the program is called the attack phase.

As conditions are improved, individual blocks or neighborhoods reach a level of environmental improvement and reduction in rat infestations defined as suitable for maintenance operations, or the maintenance phase. Criteria defining this level have been derived: (1) rat infestations on two percent or less of all premises, and (2) unapproved

refuse storage on 30 percent or less of all premises, or, exposed garbage on 15 percent or less of all premises. Both rat infestations and either of the refuse/garbage conditions must be met and maintained.

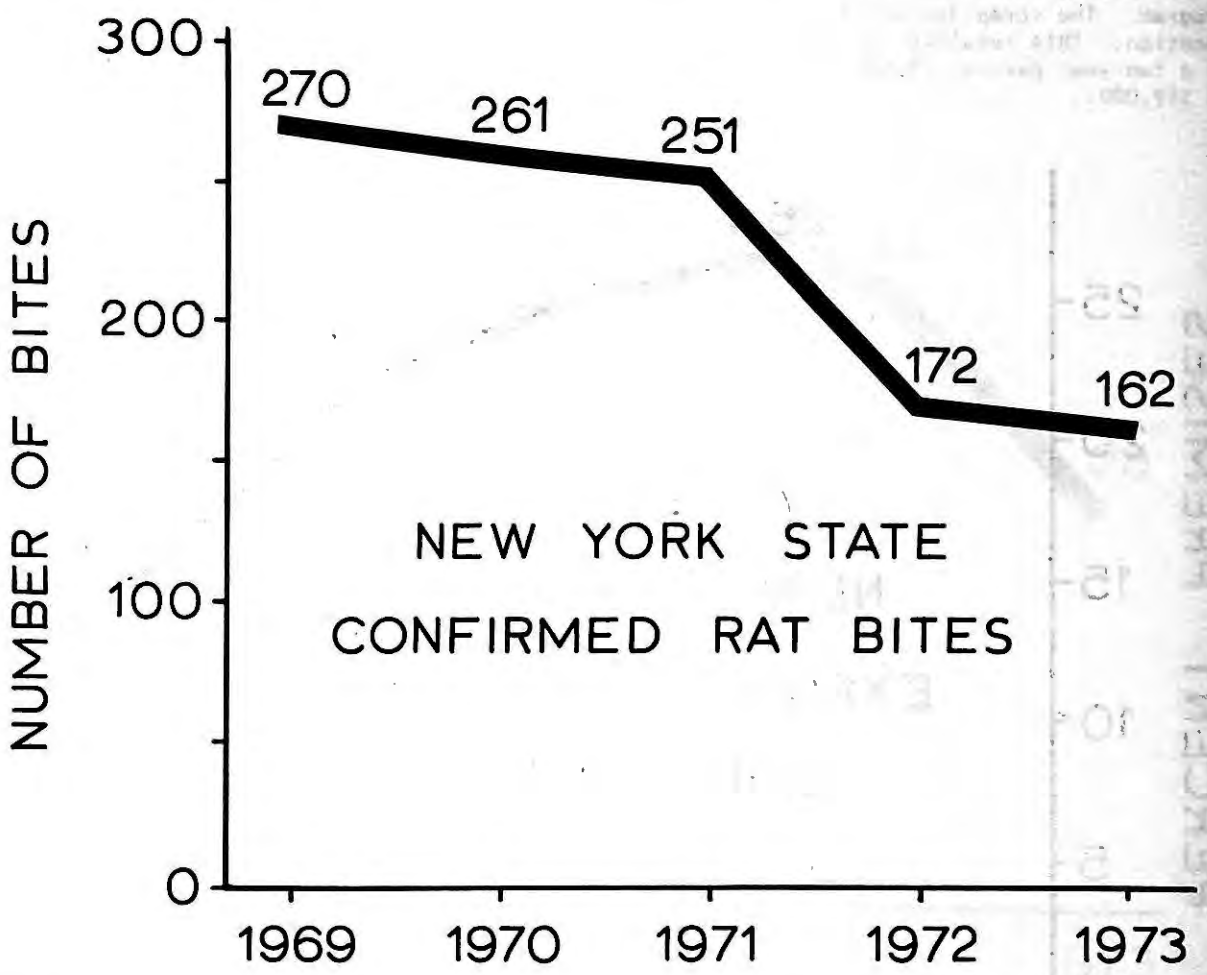

Figure 4.

Approximately 68 percent of all blocks originally in the attack phase in New York State programs are now classified as in maintenance. This does not mean that problems in these areas are licked but instead that a constant effort must be exerted to keep conditions under control.

Meanwhile resources may, in part, be diverted into other nearby neighborhoods where problems are becoming increasingly severe. The total effort required in attack, maintenance, and expanded new problem areas is certainly no less than those required in the initial phases of the program and may even be more.

Farm and Feed Mill Rodent Control

The farm surveys disclosed that rodent infestations were of significant proportions on farms in New York and that farmers wanted information and help in farm rodent control. Economic losses of animal feeds and contamination of foodstuffs justified a greater effort of rodent control than presently applied. Additional concern involved the possibility of rodents developing anticoagulant resistance on farms.

Bureau of Rodent Control staff developed an educational program for farmers. This consisted of a series of articles on the biology and control of rats and mice published in the county farm extension service monthly newspapers. In addition, a pamphlet on farm rat control, "Your Rat Free Farm," has been distributed to all county cooperative agricultural extension agents in New York for distribution as a mailer.

Rodent infestations in feed mills in New York State were also found to be of significant importance. Bureau staff members, on request of the Department of Agriculture and Markets, surveyed several feed mills for rodent infestations and then undertook cooperative control demonstrations of rodent control techniques in these mills. Special liquid anticoagulant baits were developed and tested. Following the control demonstration, Bureau staff have been invited to survey other mills and provide training to mill operators and other personnel in rodent control techniques. A pamphlet, "Your Rat Free Feed Mill," was jointly produced by the New York State Department of Health and Agriculture and Markets to provide information to mill operators.

RODENT CONTROL EVALUATION LABORATORY

One important thing that makes the New York State Rodent Control Program innovative and unique was the creation of the research and development section in the Bureau of Rodent Control known as the Rodent Control Evaluation Laboratory.

The investigations program carried out by the Rodent Control Evaluation Laboratory began by evaluating chemosterilants for rat control. Literature was reviewed on well over 100 potential rodent antifertility agents. Thirteen of these were then evaluated in the laboratory. Acceptance and efficacy data on three of these, U-5897 (an Upjohn male sterilant), quinestrol, (a Warner-Lambert modified estrogen), and BDH 10131 (a synthetic estrogen of British Drug House) justified moving ahead with field trials.

A field trial of U-5897 on a dump rat population failed to give any evidence of reduction in pregnancies despite the fact that about 80 percent of the adult males were rendered infertile (Bowerman and Brooks, 1971). This was attributed to the promiscuous breeding behavior of female rats, who sometimes mate with ten to 20 males during their estrous period. Under these circumstances, in a high-density rat population it was thought that more than 95 percent of the males must be sterilized to achieve an impact upon pregnancies.

Next, studies were carried out of quinestrol, a long-acting, fat-stored estrogen. Since the effects of quinestrol are reversible, it must be repetitively consumed by rats in order to maintain a high degree of sterility in a rat population.

Two field trials of quinestrol were carried out. The first was a short-term trial of 13 weeks using quinestrol every two weeks (Brooks and Bowerman, 1971). The second trial ran ten months and quinestrol was used once every four weeks. Both trials showed that reproduction was inhibited and recruitment of young significantly reduced so that the treated rat population was reduced by 75 percent over the 10 month period. Quinestrol, however, was not the practical rat chemosterilant needed and being sought.

The most significant aspect of the three chemosterilant field trials was the development of techniques and procedures for the field evaluation of antifertility materials. Existing procedures for the evaluation of conventional rodenticides were not applicable to chemosterilants and evaluation procedures had to be developed. Techniques developed by the Rodent Control Evaluation Laboratory have since been used by other workers in the United States and England.

Rodent Biology Studies

Early in the chemosterilant study, it became apparent that knowledge of normal population biology of wild rats living under several habitat conditions would have to be acquired. Studies of the reproductive cycle of four rat populations were completed; mortality rates in one other rat population have been estimated. Techniques of determining the past reproductive history of female rats by means of placental scars have been developed.

Feeding Preferences and Bait Development

Rat control with chemicals generally requires that rats readily consume bait containing the chemical in the presence of their normal food supply. This voluntary bait consumption is perhaps more critical with reversible sterilants which must be consumed periodically. Therefore, the Rodent Control Evaluation Laboratory has studied the food preferences of rats and discovered two outstanding new baits: hulled, proso millet and sweet rice (Brooks and Bowerman, 1973). The lab also developed a very stable, well-accepted bait block composed of paraffin, peanut meal, and zinc phosphide that is proving useful in sewer rat control.

The laboratory has assisted local rat control programs by testing the acceptability and efficacy of new rodenticidal baits and chemicals. Information from these tests aided local programs in the selection of effective baits. These bait acceptance studies also led to the discovery that the quality of some anticoagulant materials is highly variable (Bowerman and Brooks, 1972). This may lead to poor bait acceptance and ineffective control.

Anticoagulant Resistance in Rats

The occurrence of resistance to anticoagulants in rats and mice in northern Europe was one of the incentives for evaluating chemosterilants for rodent control. This resistance and the possibility that it might occur in this country because of the widespread use of anticoagulant materials in rodent control, was a prime concern of the Rodent Control Evaluation Laboratory. To aid in the detection of resistance in New York State, the laboratory started determining the anticoagulant susceptibility of wild rat populations in late 1970. A surveillance activity also was established by alerting all local programs to the dangers and signs of resistant rat populations. In March 1972 the first evidence of anticoagulant resistance was discovered in a rat population living on a turkey farm near Cambridge, New York, (Brooks and Bowerman, 1973). Several nearby farms also contained resistant rats. This pocket of resistance was subsequently exterminated with the use of acute rodenticides. Since then, ten additional anticoagulant resistant rat populations have been detected in seven counties in New York State.

Beginning in April 1972, the Rodent Control Evaluation Laboratory, in coordination with the Environmental Studies Center at Bowling Green State University, Bowling Green, Ohio, has begun the resistance screening of rats trapped from 40 cities across the country that have Federally-funded urban rat control programs. This study was begun to detect the development of resistance in rats in cities and prepare counter-measures if it was present. Since April, 1972 the Rodent Control Evaluation Laboratory has received over 1,200 rats from rat control projects in Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, and Puerto Rico.

Anticoagulant resistant rats now have been discovered in Charlotte, Chicago, Atlanta, Milwaukee, Poughkeepsie, New York City, Cohoes, Newark, East Orange, Jersey City, Hoboken, York, Washington, D. C., and Norfolk (Jackson, et. al., 1973). Steps have been taken to eliminate the resistant rat population in Washington, D. C. The other areas are being tested in greater detail to establish the extent of the resistant populations in the urban environment.

Genetic studies were done to establish the heritable nature of the resistance trait. All offspring from resistant parents from Poughkeepsie have survived the screening test, whereas only 75 percent of the offspring from resistant parent rats from North Carolina have survived. This may indicate a new, previously undescribed genetic mechanism in the Poughkeepsie rats.

The Rodent Control Evaluation Laboratory is cooperating with other investigators in the United States working on the problems of thrombi, blood clotting, and hemophilia in humans and other animals. The rat has been found to have blood clotting mechanisms identical to those in man and thus provides a useful model for such blood studies.

The data collection and analysis procedure is being adapted for electronic computer storage. A data bank of anticoagulant resistance data for all animals tested by the W.H.O. protocol by the labs at Bowling Green, Ohio, and Troy, New York will be established. As other investigators in the United States develop additional information, it will be added to the data bank and programs will be set up to analyze and print out the accumulated biological data.

SUMMARY

The rodent control program in New York State, although born of political reasons, has shown itself to be a significant factor in alleviating environmental deficiencies and rodent problems in deteriorating urban inner-city neighborhoods. Personnel drawn from disadvantaged areas of their cities have been effectively trained and utilized in staffing the rodent projects. Educational materials, especially films and school curricula are proving to be of long-lasting value. Action-oriented rodent control programs, highly visible and popular, have also shown an uncommon ability to communicate with, relate to, and acquire the trust of the community they serve.

Urban and rural problems of environmental decay, food contamination and destruction, insect and rodent infestations, and deterioration of housing, are not going to disappear overnight. The fight of man against rodent, and especially the fight of man against himself and his degradation of the environment, calls for continued action and vigilance in the years to come.

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